

AMERICAN NATIONAL STANDARD

ENGINEERING DRAWING

AND

RELATED DOCUMENTATION PRACTICES

Line Conventions and Lettering

ANSI Y14.2M - 1979

(REVISION OF Y14.2-1973)

SECRETARIAT

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THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
SOCIETY OF AUTOMOTIVE ENGINEERS

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FOREWORD

This standard is a revision of American National Standard Y14.2-1973, Line Conventions and Lettering. Certain international practices have been introduced in order to be more compatible with the International Organization for Standardization (ISO) technical drawing standards for line conventions and lettering.

Work on this revision began with a meeting in Indianapolis, April 1977. A review of ISO/R 128, ISO/R 129 and ISO 3098/I was made to determine what changes should be incorporated into ANSI Y14.2-1973 in order to implement international practices and also to introduce metric standards for line widths and letter heights for use on metric drawings. At the request of the Y14.5 Subcommittee on Dimensioning and Tolerancing certain requirements for dimension lines, extension lines and leaders covered in ANSI Y14.5-1973 were reviewed for inclusion in this standard and deletion from the next revision of ANSI Y14.5.

Another Y14.2 Subcommittee meeting was held in Indianapolis, September 1977, where the results of the first draft balloting within the Subcommittee were reviewed and preparations made for the final draft which was submitted for Y14 Committee ballot.

The following is a summary of the significant changes made in this revision:

- Metric standard line widths, 0.35 mm for thin and 0.7 mm for thick, were adopted and are a selection from ISO/DIS 128-1977—Principles of Presentation, and ISO 3098/I-1974—Lettering—Part I: Currently Used Characters.
- Permission is given for the use of one line width for all lines where the drawing is prepared by computerized mechanical equipment.
- The symmetry line from ISO/DIS 128 was adopted.
- Chain line from ISO/DIS 128 was adopted for the indication of lines or surfaces to which special requirements apply.
- Open style as well as filled arrowheads are recognized to accommodate the computer made drawings.
- Introduced metric standard letter heights for metric drawings, which are a selection from ISO 3098/I.

Suggestions for improvement of this standard will be welcome. They should be sent to the American National Standards Institute, 1430 Broadway, New York, NY 10018.

This revision was approved by the American National Standards Institute (ANSI) on 4 January 1979.

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AMERICAN NATIONAL STANDARD

LINE CONVENTIONS AND LETTERING

1 GENERAL

This standard establishes the line and lettering practices for use in the preparation of engineering drawings.

2 SCOPE

This standard includes the recognition of the requirements for photographic reduction and reproduction, including microfilm, as well as the conventional methods of reproduction.

3 LINE CONVENTIONS

These describe the size, construction, and applications of the various lines used in making engineering drawings.

3.1 Line Widths

Two widths of lines, as shown in Figure 1, are recommended for use on manually prepared drawings. One width of line is acceptable on drawings prepared mechanically and on undimensioned drawings. The ratio of line thicknesses should be approximately two-to-one. It is recommended that the thin-line width be approximately 0.35 mm or 0.016 inch and the thick-line width be approximately 0.7 mm or 0.032 inch.¹ The actual width of each line shall be governed by the size and style of the drawing, and the smallest size to which it is to be reduced. All lines of the same type should be uniform throughout the drawing. Spacing between parallel lines should be such that there is no fill-in when reproduced by available photographic methods. Note: Spacing of no less than 1.5 mm (0.06 inch) normally meets reproduction requirements.

3.1.1 All lines should be clean-cut, opaque, uniform, and properly spaced for legible reproduction by all

commonly used methods, including microfilming in accordance with industry and government requirements. There should be a distinct contrast between the two widths of lines.

3.2 Visible Lines

Visible lines, Figures 1 and 2, consist of solid thick lines and shall be used for representing visible edges or contours of objects. Visible lines should be drawn so that the views they outline clearly stand out on the drawing with a definite contrast between these lines and secondary lines.

3.3 Hidden Lines

Hidden Lines, Figures 1 and 2, consist of short evenly-spaced thin dashes and are used to show the hidden features of an object. The lengths of the dashes may vary slightly in relation to the size of the drawing. Hidden lines should always begin and end with a dash in contact with the visible or hidden line from which they start or end, except when such a dash would form a continuation of a visible line. Dashes should join at corners, and arcs should start with dashes at tangent points. See Figure 3. Hidden lines should be omitted when their use is not required for the clarity of the drawing.

3.3.1 Although features located behind transparent materials may be visible, they shall be treated as concealed features and shown with hidden lines.

3.4 Section Lines

Section lines, Figures 1 and 2, consist of a solid thin line used to indicate the cut surfaces of an object in a section view. Section lining symbols are shown in Figure 9. See 5.2 and 5.3.

3.5 Center Lines and Symmetry Lines

These are constructed in the same manner, that is, they consist of alternating long and short thin dashes. See Figures 1 and 2.

¹ The metric line widths agree with the International Organization for Standardization draft international standard ISO/DIS 128 (June 1977)—Principles of presentation, and are not a soft metric conversion of the inch values.

3.5.1 Center lines. These are used to represent axes of symmetrical parts and features, bolt circles, and paths of motion. See Figures 2 and 3. The long dashes of the center lines may vary in length, depending upon the size of the drawing. Center lines should start and end with long dashes and should intersect by crossing the long or short dashes. Center lines should extend uniformly and distinctly a short distance beyond the object or feature of the drawing unless a longer extension is required for dimensioning or for some other purpose. They should not terminate at other lines of the drawing nor should they extend through the space between views. Very short center lines may be unbroken if no confusion results with other lines.

3.5.2 Symmetry line. This is a center line used as an axis of symmetry for a partial view. The line of symmetry is identified by two thick short parallel lines drawn at right angles to it. Symmetry lines are used when representing partially drawn views and partial sections of symmetrical parts. See Figure 3. Symmetrical view visible and hidden lines may extend past the symmetry line if clarity would be improved.

3.6 Dimension Lines, Extension Lines, and Leaders

These are solid thin lines used for dimensioning drawings as described in the following paragraphs.

3.6.1 Dimension lines, Figures 1 and 2, are used to indicate the extent and direction of dimensions, and are terminated by neatly made uniform arrowheads. The arrowheads shall be drawn within the limits of the dimension line if possible. See Figure 4(a). Where inadequate space is available, the arrowheads may be shown outside the dimensional limit. See Figure 4(b).

3.6.2 Extension lines, Figures 1 and 2, are used to indicate the point or line on the drawing to which the dimension applies. They are also used to indicate the extension of a surface to a theoretical intersection. See Figure 5.

3.6.3 Leaders, Figures 1 and 2, are used to direct notes, dimensions, symbols, item numbers, or part numbers to features on the drawing. A leader should, generally, be a single straight inclined line (not vertical or horizontal) except for a short horizontal portion extending to the center of the height of the first or last letter or digit of the note. This horizontal portion is optional and if used it should not underline the note. The leaders should terminate as follows:

(a) Without symbol, if they end on a dimension line, see Figure 6(a).

(b) With a dot 1.5 mm (0.06 inch) minimum diameter, if they end within outlines of an object, see Figure 6(b).

(c) With an arrowhead, if they end on the outline of an object, see Figure 6(c).

(d) With or without a dot or arrowhead on drawings prepared by computer automated techniques. Leaders should not be bent in any way unless unavoidable. Two or more leaders to adjacent areas on the drawing should be drawn parallel.

3.6.3.1 In drawing leaders, avoid the following:

(a) Crossing of leaders.

(b) Long leaders.

(c) Horizontal or vertical leaders.

(d) Leaders that are parallel to adjacent dimensions, extension or section lines.

(e) Small angles between leaders and terminating surfaces.

3.7 Cutting-Plane and Viewing-Plane Lines

Cutting-plane and viewing-plane lines, Figures 1 and 2, are used to indicate the location of cutting planes for sectional views and the viewing position for removed partial views. Two forms of cutting-plane and viewing-plane lines are approved for general use as follows:

(a) Figure 1 (line 8), consists of evenly-spaced thick dashes. On drawings with a high density of line-work, this form may be modified by omitting the dashes between the line ends for the purpose of obtaining clarity.

(b) Figure 1 (line 9), consists of alternating long thick dashes and pairs of short thick dashes. The long dashes may vary in length, depending on the size of the drawing.

3.7.1 Both forms of cutting-plane and viewing-plane lines should be drawn to stand out clearly on the drawing. The ends of the lines are at 90 degrees and terminated by bold arrowheads to indicate the direction of sight for viewing the section. See Figure 2.

3.8 Break Lines

Two forms of break lines are approved for general use as follows:

(a) A freehand thick line, Figure 1 (line 10). Also, see Figure 2.

(b) Long ruled thin dashes joined by zigzags. See Figure 1 (line 11). Also, see Figure 8(a).

See the American National Standard on Multi and Sectional View Drawings, Y14.3-1975 for application of break lines.

3.9 Phantom Lines

Phantom lines consist of long thin dashes separated by pairs of short thin dashes. Phantom lines should start and end with long dashes which may vary in length, depending on the size of the drawing. See Figure 1 (line 12). Phantom lines are used to indicate alternate positions of moving parts, Figure 2; adjacent positions of related parts, Figure 8(a); and repeated detail, Figure 8(b), (c), and (d). See ANSI Y14.3-1975 for application of phantom lines.

3.10 Stitch Lines

Two forms of stitch lines are approved for general use as follows:

(a) Consisting of short thin dashes and spaces of equal lengths.

(b) Consisting of dots approximately 0.35 mm diameter (0.016 inch), 3 mm (0.12 inch) apart.

Stitch lines are used for indicating a sewing or stitching process. See Figure 1 (lines 13 and 14).

3.11 Chain Lines

Chain lines, Figure 1 (line 15) consist of thick alternating long and short dashes. This line is used to indicate that a surface or surface zone is to receive additional treatment or consideration within limits specified on the drawing. See Figure 2.

4 ARROWHEADS

Arrowheads may be prepared manually or mechanically. For various arrowhead styles, see Figure 7. The recommended length and width should be a ratio of approximately 3:1. The width of the arrowhead should be proportionate to the thickness of the lines used. A single style of arrowhead should be used throughout the drawing.

5. SECTION LINING

This identifies the cut surfaces of sectional views. Section lining may be used when necessary to distinguish individual components of an assembly or to distinguish different surface levels of a full or partial section through a part.

5.1 General Principles

Sections should be drawn to show interior construction which cannot be clearly shown by hidden

lines in exterior views. A section is drawn to show how the object would appear if an imaginary cutting plane were passed through the object perpendicular to the direction of sight and the portion of the object between the observer and the cutting plane were removed or broken away. The exposed cut surface of the material is indicated by section lining or cross-hatching. Section lines of sectional views should be drawn on the working side (image surface) of the drawing. See ANSI Y14.3-1975 for sectioning details.

5.2 Section Lining on Detail Drawings

Since material specifications cannot be accomplished with section lining symbols alone, the general-purpose section lining symbol is to be used on detail drawings. See Figure 9(a). The exact material specifications should be given elsewhere in note form. An exception may be made for wood when it is desirable to show the direction of the grain.

5.2.1 Section lines should be uniformly spaced. Spacing should be as generous as possible and yet preserve the unity and contrast of the sectioned areas.

5.2.2 Dimensions or other lettering should not be placed in sectioned areas. When this is unavoidable, the section lining should be omitted in the area for the numerals or lettering. See Figure 11.

5.3 Section Lining on Assembly Drawings

General-purpose section lining, Figure 9(a) is to be used on assembly drawings.

5.3.1 When several adjacent parts are shown in a sectioned view, the parts should be sectioned as shown in Figure 11.

5.3.2 Symbolic section lining, Figure 9, may be used on special purpose assembly drawings such as illustrations for parts catalogs, display assemblies, promotional materials, when it is desirable to distinguish between different materials. See Figure 10. Symbolic section lining is not recommended for drawings that will be microfilmed.

5.4 Direction and Spacing of General-Purpose Section Lines

General-purpose section lining should be drawn at an angle of 45 degrees with the main outlines of the view. See Figure 11(a). On adjacent parts, the section lines should be drawn in the opposite direction. See Figure 11(b). For additional adjacent parts any suitable angle may be used to make each part stand out

separately and clearly. See Figure 11(c). Section lines should not be purposely drawn to meet at common boundaries. When the shape or position of a section area is such that the section lines would be parallel or perpendicular (or nearly so) to a prominent visible line bounding the sectioned area, a special angle should be chosen. See Figure 12.

5.4.1 In sectional views of single pieces, alone or in assembly, section lines in all sectioned areas should be parallel and uniformly spaced. See Figure 13.

5.4.2 Limited section lining drawn adjacent to the boundaries only of the sectioned area (outline section lining) is preferred for large areas, provided clarity is not sacrificed. See Figure 14.

5.4.3 Sections which are too thin for effective section lining, such as sheet metal items, packing, and gaskets, may be shown without section lining or the area may be filled in completely. See Figure 15.

6 LETTERING

This identifies the type and style of lettering for use on engineering drawings.

6.1 Single-Stroke Gothic Lettering

Lettering on drawings must be legible and suitable for easy and rapid execution. These requirements are met in the recommended single-stroke gothic characters shown in Figures 16 and 17 or adaptations thereof, which improve reproduction legibility. One such adaptation by the National Micrographics Association is the gothic style Microfont alphabet intended for general usage. See Figure 18. Opaque and well spaced lettering is required on the drawing for microfilm reproduction.

6.1.1 Either inclined or vertical lettering is permissible. Only one style of lettering should be used throughout a drawing. The preferred slope for the inclined characters is 2 in 5 or approximately 68 degrees with the horizontal. See Figure 16.

6.1.2 Upper case letters shall be used for all lettering on drawings unless lower case letters are required to conform with other established standards, equipment nomenclature or marking. See Figures 16 and 17. When additions or revisions are made, the original style of lettering should be maintained.

6.1.3 Lettering of titles, subtitles, drawing numbers, and other uses may be made freehand, by typewriter, or with the aid of mechanical lettering devices such as

templates and lettering machines. Regardless of the method used, all characters are to conform, in general, with the recommended gothic style and must be legible in full or reduced size copy by any accepted method of reproduction.

6.1.4 The recommended minimum freehand and mechanical letter heights for various size drawings are given in Table 1.

6.1.5 Letters in words should be spaced so that the background areas between the letters are approximately equal, and words are to be clearly separated by a space equal to the height of the lettering. A space between letters of at least 1.5 mm (0.06 inch) is recommended. The space between two numerals having a decimal point between them is to be a minimum of two thirds the height of the lettering. Sentences should be separated horizontally by a space equal to twice the height of the lettering. The vertical space between lines of lettering should be no more than the height of the lettering, and no less than half the height of the lettering.

6.1.6 Notes should be placed horizontally on drawings and separated vertically by spaces at least equal to double the height of the character size used, to maintain the identity of each note.

6.1.7 The division line of a common fraction should be parallel to the direction in which the dimension reads and should be separated from the numerals by a minimum of 1.5 mm (0.06 inch) spacing. When fractions occur in notes, tables, and lists, the diagonal division line is permissible. Numerals in fractions should be the same size as other numerals.

6.1.8 Lettering should not be underlined except when special emphasis is required. The underlining should not be less than 1.5 mm (0.06 inch) below the lettering.

6.1.9 The lettering heights, spacing, and proportions in Figures 16, 17, and 18 and also Table 1 normally provide acceptable reproduction or camera reduction, and blow back. However, manually, mechanically, opti-mechanically, or electro-mechanically applied lettering (typewriter, etc.) with heights, spacing, and proportions other than those recommended are acceptable when the minimum reproducibility and legibility requirements of the accepted industry or military reproduction specifications are met. Therefore, the basic requirement for lettering on a drawing is that it produce fully legible copies.

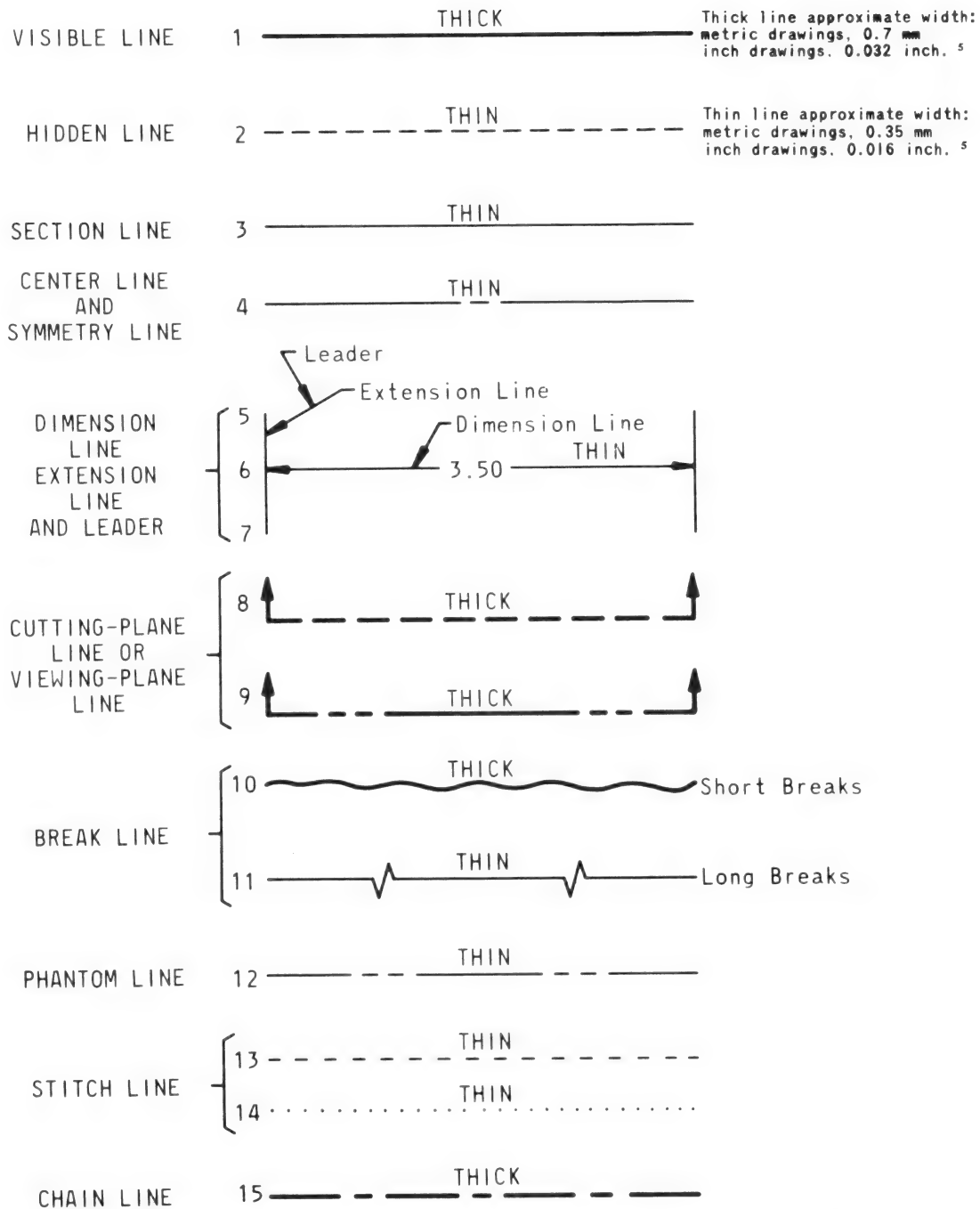
Table 1 Recommended Minimum Letter Heights ²

METRIC ³ mm		USE	INCH		DRAWING SIZE
FREEHAND	MECHANICAL		FREEHAND	MECHANICAL	
7	7	DRAWING NUMBER IN TITLE BLOCK	0.312	0.290	LARGER THAN 17 x 22 INCHES
			0.250	0.240	UP TO AND INCLUDING 17 x 22 INCHES
7	7	DRAWING TITLE	0.250	0.240	ALL
7	7	SECTION AND TABULATION LETTERS	0.250	0.240	
5	5	ZONE LETTERS AND NUMERALS IN BORDERS	0.188	0.175	
3.5	3.5	DIMENSION, TOLERANCES, LIMITS, NOTES, SUBTITLES FOR SPECIAL VIEWS, TABLES, REVISIONS, AND ZONE LETTERS FOR THE BODY OF THE DRAWING	0.125	0.120	UP TO AND INCLUDING 17 x 22 INCHES
5	5		0.156 ⁴	0.140 ⁴	LARGER THAN 17 x 22 INCHES

² See paragraphs 6.1.3 and 6.1.9 for other permissible lettering methods and letter heights.

³ The metric letter heights agree with ISO 3098/1-1974—Lettering—Part 1: Currently Used Characters, and are not soft metric conversions of the inch values.

⁴ When drawing information contains upper and lower case lettering, it may be necessary to have the upper case lettering height at a minimum of 0.180 inch to assure legible lower case lettering on prints made from microfilm.



5 The metric line widths agree with ISO/DIS/128 (June 1977) and are not a soft metric conversion of the inch value.

These approximate line widths are intended to differentiate between THICK and THIN lines and are not values for control of acceptance or rejection of the drawings.

FIG. 1 WIDTH AND TYPE OF LINES

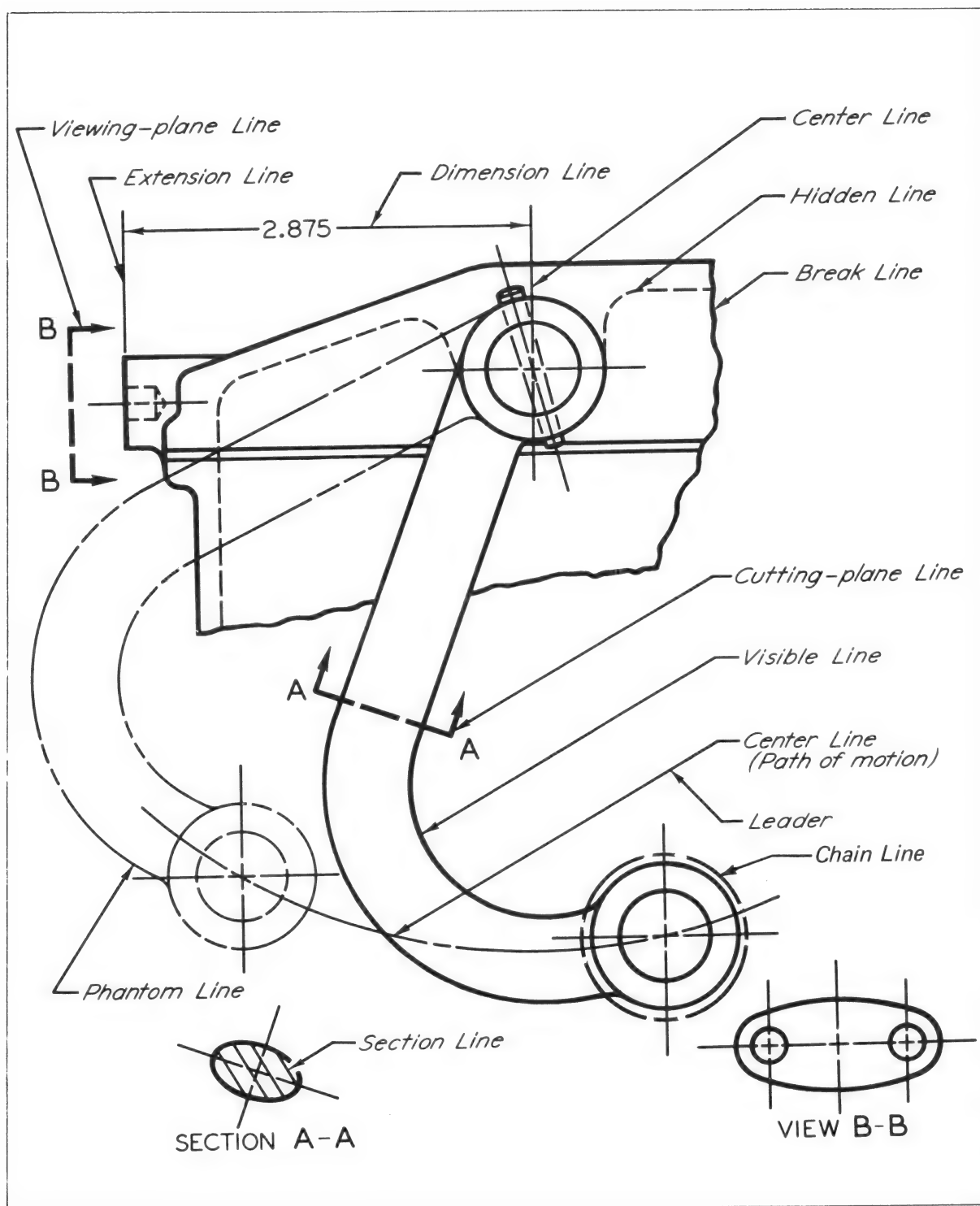


FIG. 2 APPLICATIONS OF LINES

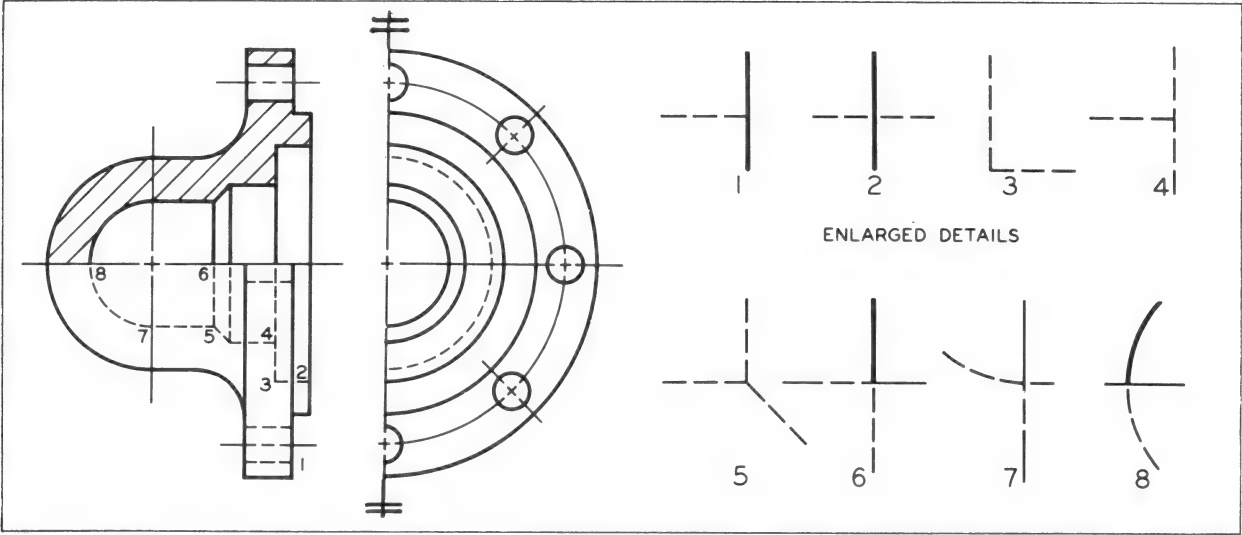


FIG. 3 HIDDEN LINE TECHNIQUE AND SYMMETRY LINE APPLICATION

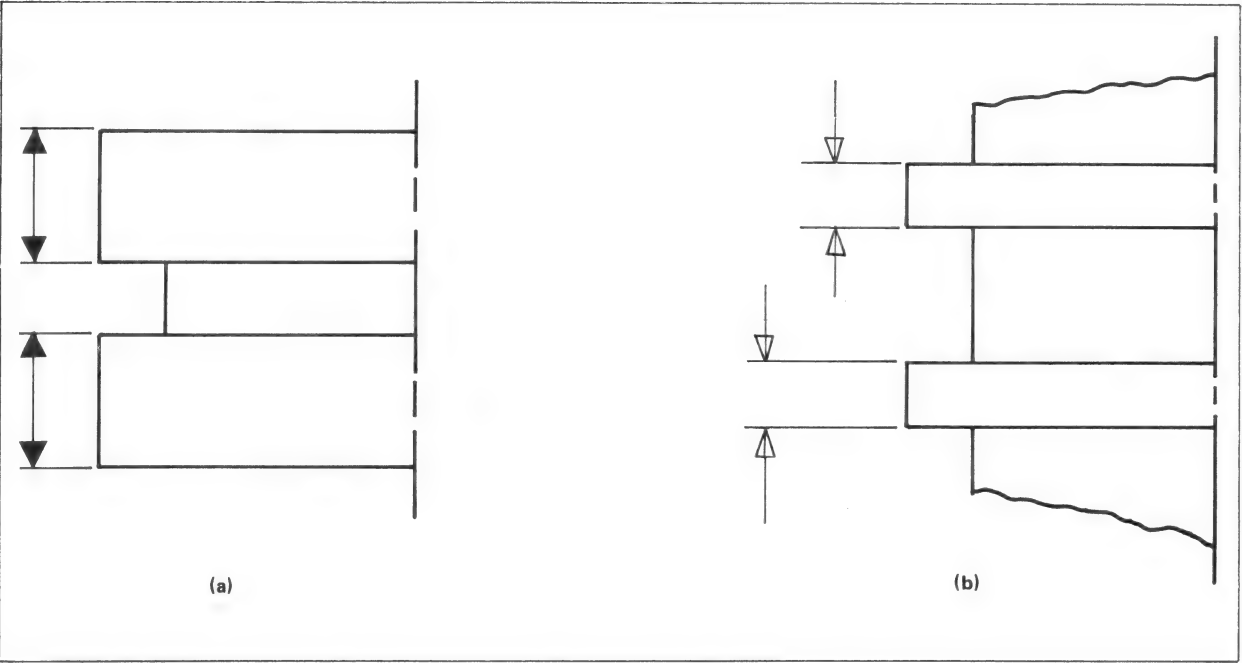


FIG. 4 ARROWHEAD PLACEMENT ON DIMENSION LINES

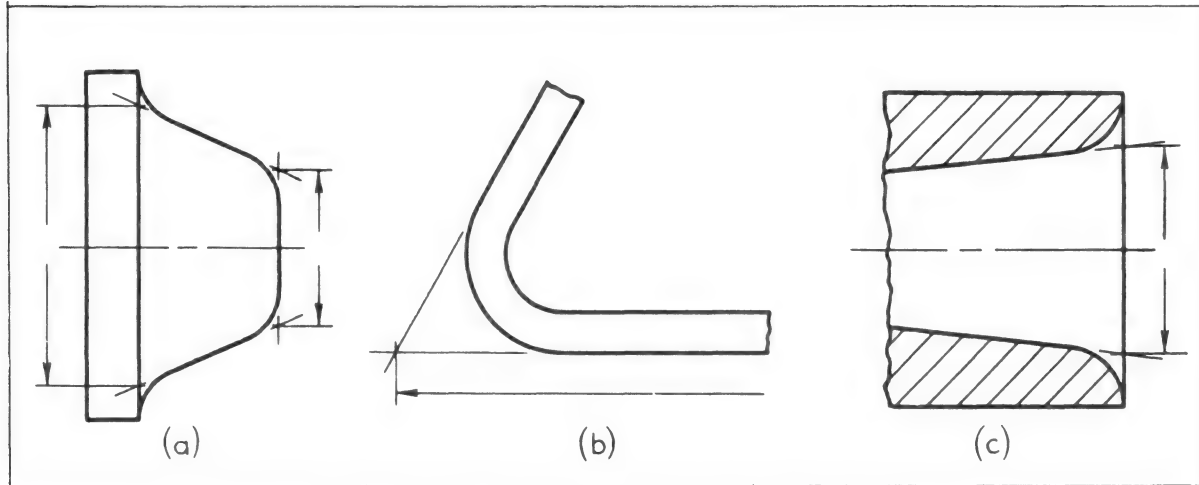


FIG. 5 SPECIAL APPLICATIONS OF EXTENSION LINES

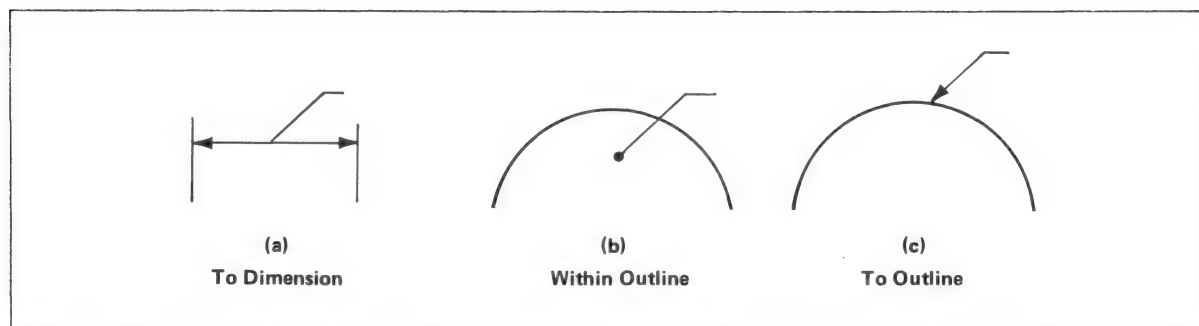


FIG. 6 TERMINATION OF LEADERS



FIG. 7 ARROWHEAD STYLES

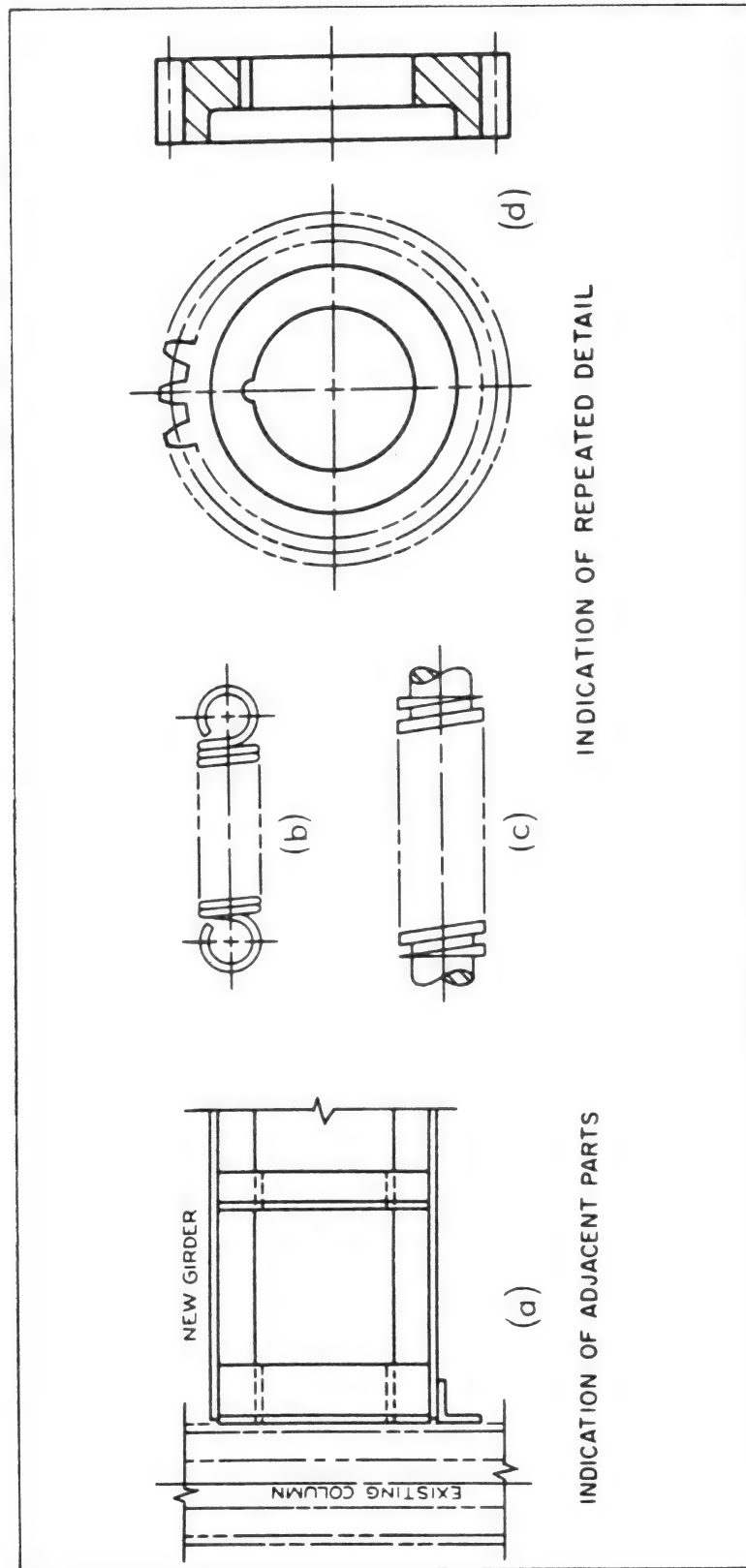


FIG. 8 PHANTOM LINE APPLICATIONS

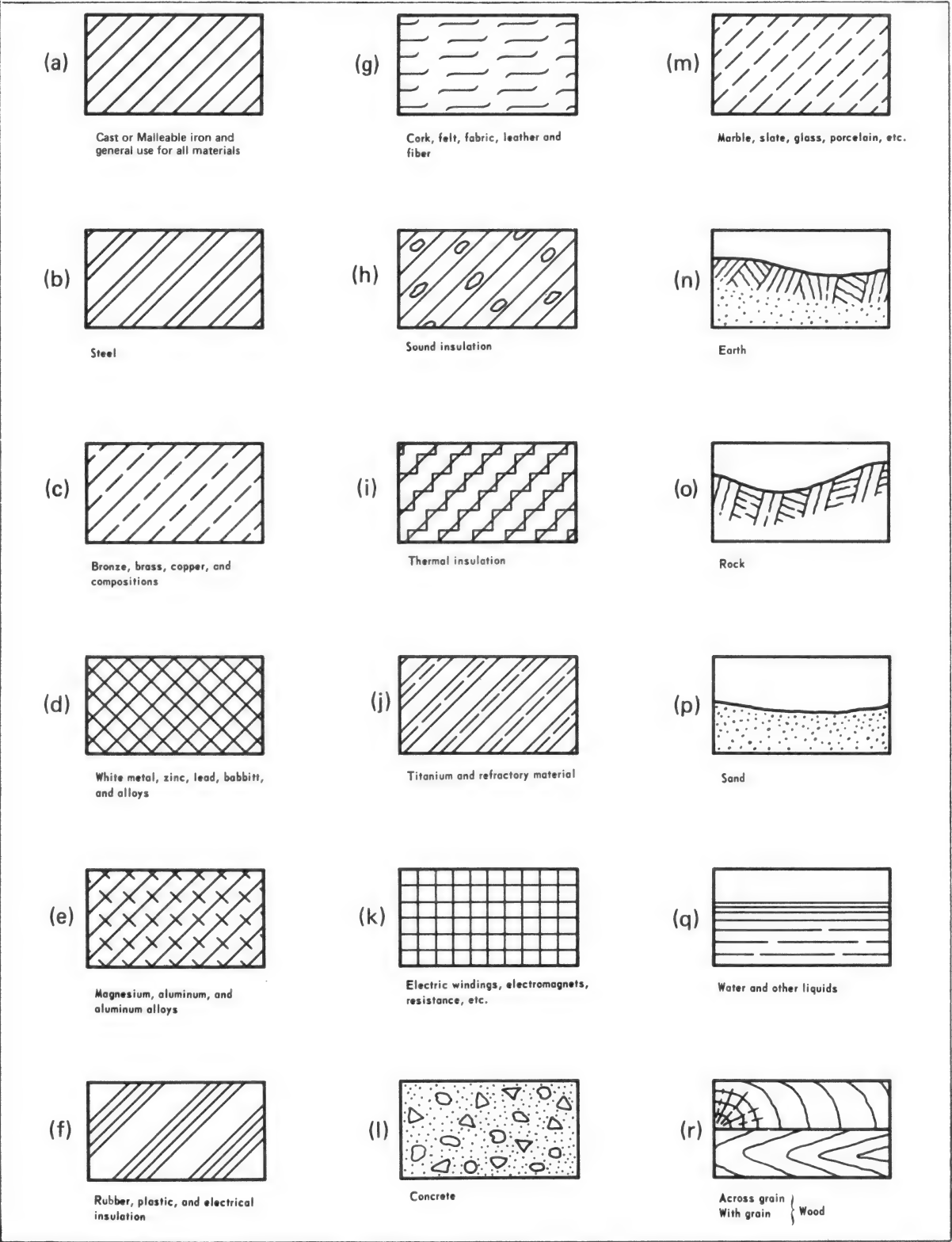


FIG. 9 SECTION LINING SYMBOLS

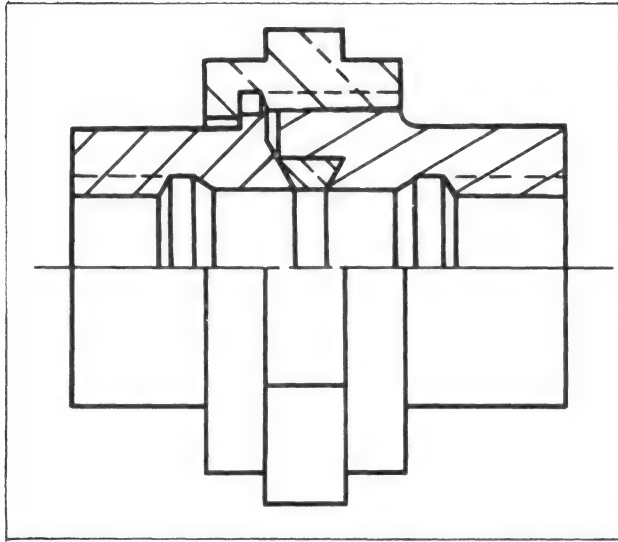


FIG. 10 REPRESENTATION OF MATERIALS IN ASSEMBLY

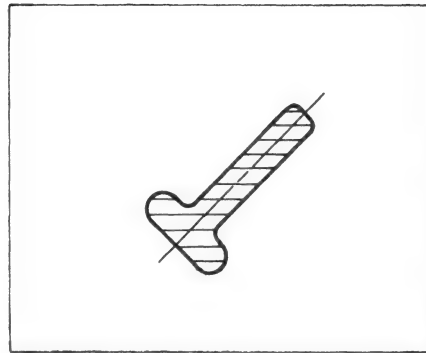


FIG. 12 DIRECTION OF SECTION LINES

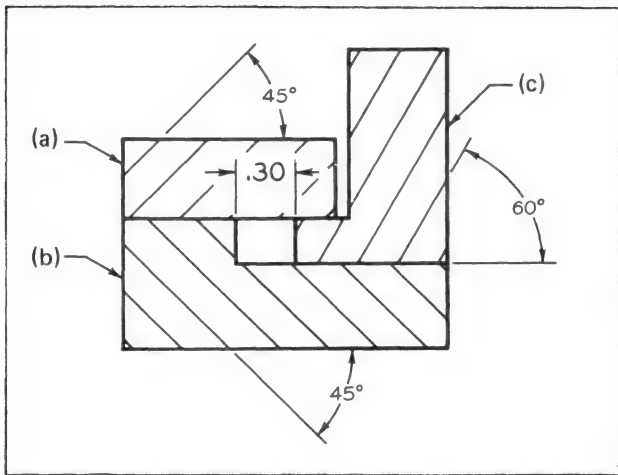


FIG. 11 SECTION LINING OF ADJACENT PARTS

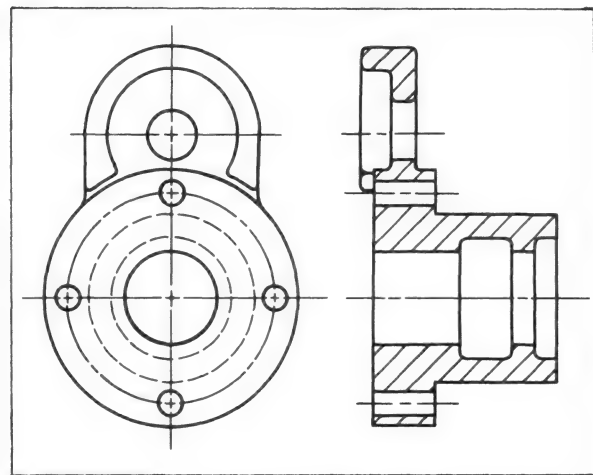


FIG. 13 FULL SECTION

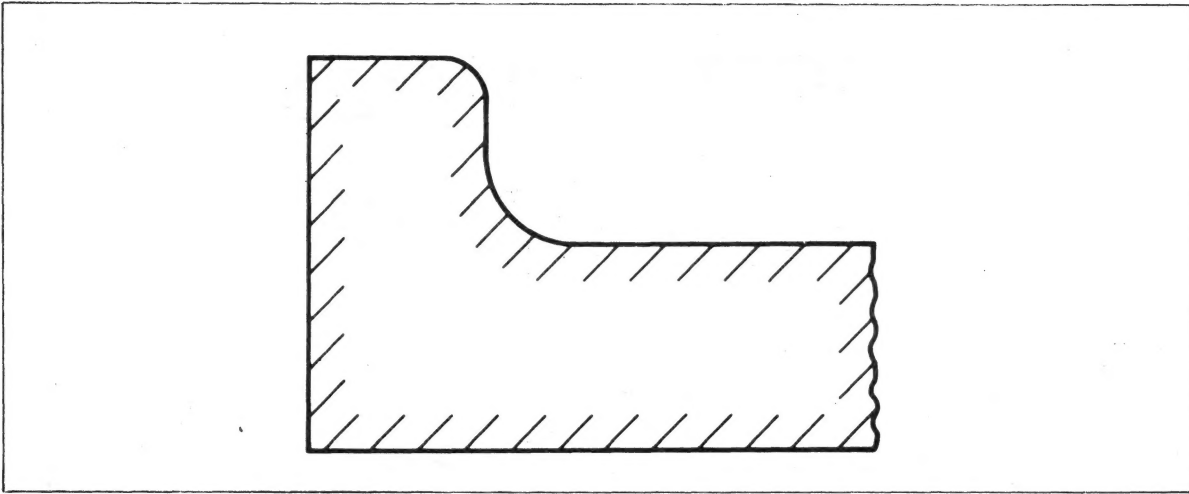


FIG. 14 OUTLINE SECTION LINING

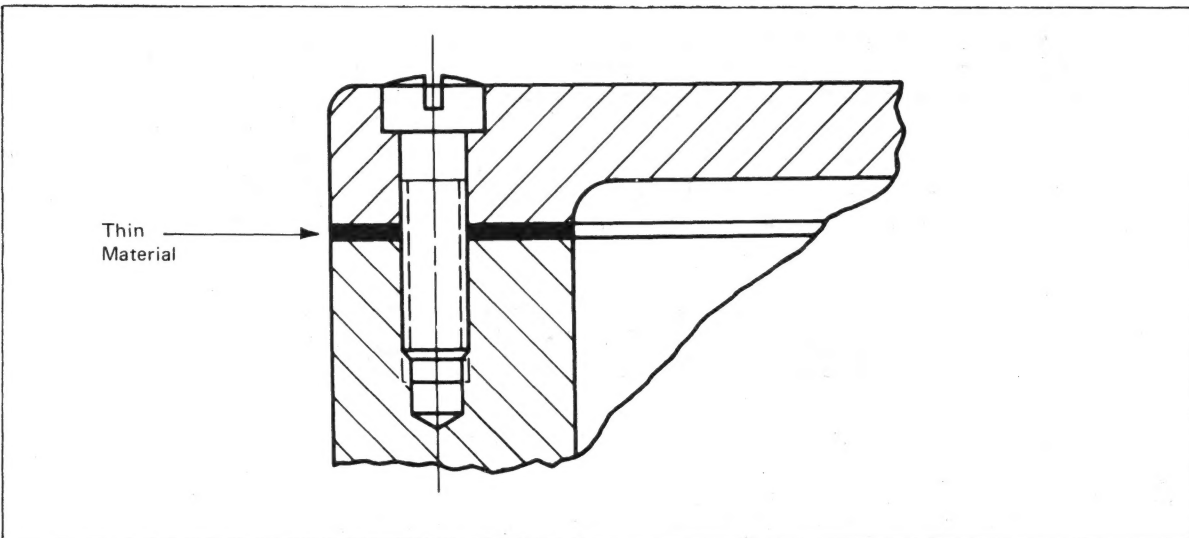


FIG. 15 THIN MATERIAL IN SECTION



FIG. 16 INCLINED LETTERS



FIG. 17 VERTICAL LETTERS

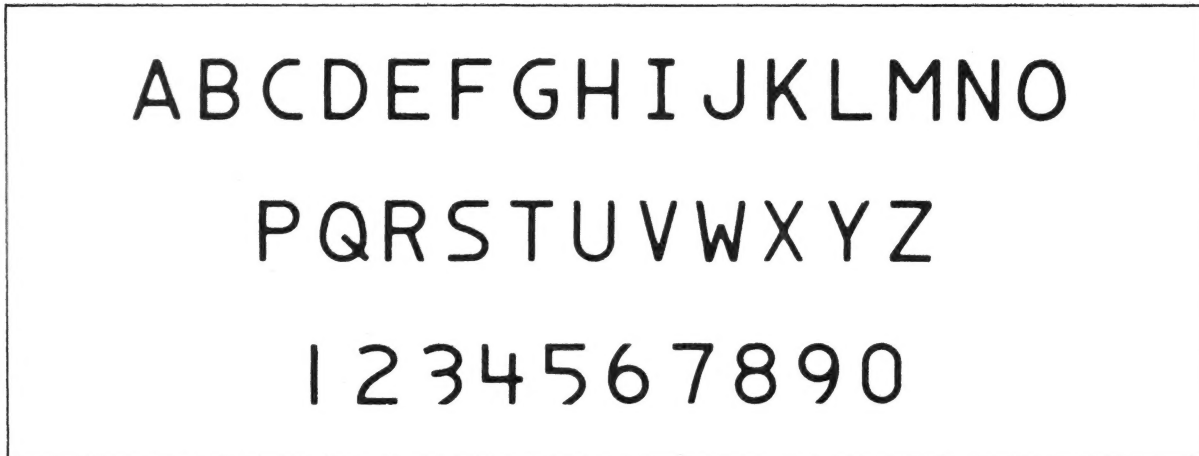


FIG. 18 MICROFONT LETTERS

